4. EARLY IDENTIFICATION OF LIKELY RESPONSE ACTIONS

Introduction

Principle 3: Early identification of likely response actions is possible, prudent, and necessary.

Early identification of likely response actions is possible because of the lessons learned from over 20 years of conducting environmental restoration efforts in this country. It is prudent because it can help focus subsequent activities, and it is necessary because resource limitations dictate against expenditures that do not directly support attainment of the PMT's objective. The third Principle assists in addressing the second key environmental restoration question (i.e., what should be done in response to a problem?). Hence, while the second Principle (problem identification) is directed toward identifying *what* needs to be accomplished, the third Principle is focused on *how* it is to be accomplished.

Early versions of the environmental restoration program established a process that utilized sequential activities. Initial efforts involved data collection to characterize a site, followed by analysis of all possible technologies to select the best response for resolving the problem. Two decades of experience, however, indicate that for many common scenarios, there are only a few (and often only one) technologies that will survive the selection process as the preferred choice. Indeed, recognizing circumstances when a single technology is inevitably the best selection, the EPA has developed presumptive remedies that can be selected without extensive analysis when site characteristics so warrant. The third Principle is an acknowledgement of the accumulated experience from previous efforts (i.e., it is possible to focus efforts early, and in so doing, reduce time and cost associated with evaluating alternatives that will never be selected).

This chapter discusses the merits of early identification of likely response actions through development of a hierarchy of preferred technologies, and the use of that short list of candidate responses to identify data needed to select and design the final remedy.

Shifting the Focus of Investigations

Problems, by definition, require a response. Therefore, once it is determined that a problem exists, the focus of investigations should shift from problem definition, to identifying the most likely response, or set of response actions, to address the problem. Identifying the likely response early allows the PMT to begin to focus on a remediation strategy and data needs to evaluate the suite of technologies identified as possible candidates. It helps ensure that investigation and data

collection activities only take place to the extent they support the selection and design of likely response actions. This approach does not preclude a broad technology evaluation, or consideration of innovative approaches. Rather, because it seeks to eliminate those technologies with obvious fatal flaws from the range of options, it allows the PMT to seek early consensus on the likely range of potential solutions to the problem identified, including innovative possibilities.

There is no obligation under either RCRA or CERCLA to evaluate a fully comprehensive suite of alternative actions. Under CERCLA, the only remedy that must always be evaluated is no further action (NFA). Similarly, under RCRA, project managers are only required to bring forward one remedy that will meet the remediation objectives. Eliminating less viable response options early eliminates unnecessary analyses and documentation and, therefore, saves time and resources. Time is a yardstick of PMT performance; public confidence can decline and risk to project success can increase over time with inaction. Although the PMT may in fact be busy evaluating a multitude of options, in public perception, because no decisions have been made, confidence declines. A bias toward reducing the timeframe over which a given level of risk persists increases public confidence and decreases cost by eliminating unnecessary activities such as unnecessary data collection and investigation for a remedy that will clearly not meet the remediation objectives.

In addition to evaluating technical approaches, regulatory requirements must be evaluated to determine which authorities are most likely to drive decisions. As noted in the previous chapter, if a response is required regardless of risk implications, there is no utility in conducting a risk assessment. Conversely, if there is no legal driver, there may be no justification for expenditures on any kind of response (tantamount to saying there is no problem). Hence, identification of legal drivers is an important aspect of verifying the need for a response, as well as sorting through viable alternatives.

Benefits of Early Identification

Early identification of likely response actions allows:

- Early focus on appropriate remedial action objectives and key elements of an exit strategy.
- Early consideration of the implications of potential response actions and the data needs associated with ultimate selection and design of a remedy.
- Development of a hierarchy of probable technologies for a defined problem such that data collection targets only those data that are critical to evaluation of only those options that are likely to be viable.

- Early consideration of presumptive remedies, generic approaches, and a phased response.

- Implementation of removal and/or interim actions that restore the environment in lieu of studies and may minimize some unproductive activities such as redundant characterization and risk assessments of conditions obviously in need of a response.

Early identification and communication of response actions can streamline:

- Workplan development;
- Sampling and analysis needs;
- Technology evaluation;
- Documentation; and
- Design.

In essence, by focusing on a limited number of technologies early in the investigation, it is possible to address most data needs in a single or limited data collection campaign, thereby reducing mobilization and demobilization costs and time requirements to get to a decision point. Moreover, costs associated with data for the sole purpose of evaluating technologies that will never be selected are minimized. While the optimum would be to focus on the single preferred technology, the reality is that it may not be possible to eliminate all alternatives until much of the characterization work is complete. Therefore, early identification efforts target development of a short list of likely responses. This list is modified as new information is developed.

Hierarchy of Preferred Technologies

Categorizing problems includes considering likely responses. Ideally, the PMT identifies likely response actions for high priority concerns as early in the process as possible. However, there is a balance that must be struck. If identification is too early, it may well address the wrong problem, thereby leading to unnecessary activities. In general, identification of likely response actions begins when a potential problem is identified. In fact, it may be possible to identify a very limited number of response actions with only the identity of the contaminant and affected media known.

The Army has over 20 years of experience in selecting, implementing, and evaluating long-term performance of remedies at contaminated installations. The knowledge of what has and has not worked that can be distilled from that experience often allows the identification of a very limited number of technologies that comprise the hierarchy of preferred technologies. It is a hierarchy because technologies are listed in order of preference. The technologies are preferred because they have a history of being the most cost-effective, most often selected, and most successful. By focusing on this hierarchy, it is possible to

anticipate data needs for the selection of one technology. Moreover, by narrowing the field of technologies early in the process, it is easier to commit resources to looking at innovative technologies with the potential to address weaknesses in more common candidates.

An example hierarchy of preferred remedies for groundwater remediation under two scenarios follows:

Scenario 1: High Permeability
1. Monitored Natural Attenuation
2. Recirculating Wells
3. In Situ Air Sparging
4. Enhanced Bioremediation
5. Pump and Treat

Scenario 2: Low Permeability
1. Monitored Natural Attenuation
2. Treatment Barriers
3. Enhanced Permeability Pump and Treat
4. Electrokinetics

If presumptive remedies exist, they should be at the top of the list of likely response actions. Presumptive remedy guidance introduces significant information on the data needs and methods to evaluate the efficiency of presumptive technologies. Moreover, presumptive remedies for specific sources, such as SVOC from wood treating, are applicable to SVOC from other sources as well. Presumptive remedy documents are available at http://www.epa.gov/superfund/resources/presump.

Based on current presumptive remedy guidance from the EPA, there is a hierarchy of preferred technologies for every major category of contaminant in soil:

Volatile Organic Compounds
1. Soil vapor extraction (SVE)
2. Excavation with thermal desorption
3. Excavation with incineration

Semivolatile Organic Compounds
1. Biological degradation (either in situ or ex situ)
2. Excavation with thermal desorption (not recommended for explosive contamination above detonation thresholds)
3. Excavation with incineration

Metals and Inorganic Contaminants
1. Reclamation/recovery
2. Solidification/Stabilization
3. Containment e.g., capping

For solid waste landfills, the presumptive remedy is capping after identification and removal of large deposits of drummed liquid wastes.

For ground water, the default remedy has been extraction with wells or trenches followed by treatment. Innovative technologies such as permeable treatment barriers and in situ oxidation are demonstrating sufficient promise that they may soon be recognized as presumptive for sites with specific characteristics.

Removal and interim actions eliminate unnecessary characterization efforts and can reduce the likelihood of extensive, low value requirements in the future while facilitating more rapid closeout.

Technology-Driven Data Needs

As mentioned earlier in this chapter, once a problem has been substantiated, the focus of investigations should turn to identification of likely response actions. When likely response actions have been identified, data needs include the information required to assess fatal flaws and characterize selection parameters to assist the PMT in choosing among remedies. *Fatal flaws* are site conditions or parameter values that would make a remedy impossible to implement effectively or render it much less desirable relative to other remedies. Examples of fatal flaws for possible remedies include the following:

- Caps - waste buried below water table so that dissolution will continue even if infiltration is eliminated.
- Excavation - contaminant lies below buildings in active use whose structural integrity and utilities cannot be safely jeopardized.
- Permeable Treatment Wall - absence of an impermeable layer to key the wall into so that plume underflow is likely.

Selection and design parameters are conditions or characteristics the nature/value of which will affect whether one remedy would be preferred over another, and how the selected remedy would be designed. Examples of selection and design parameters include:

- Caps - nature of release mechanism of concern (i.e., volatilization such that gas migration or extraction controls are required; direct contact such that armoring or a buffer of clean soil and access restrictions are required; infiltration/percolation to groundwater such that an impermeable layer and/or net positive evapotranspiration balance are required).
- Excavation - depth of contamination with respect to selection among various options for equipment with different depth capabilities.
- Permeable Treatment Wall - aquifer permeability from which wall thickness and/or continuous vs. funnel and gate decisions are made.

Design basis questions are a tool that can be applied to identify fatal flaws and selection parameters for most common remedies. The design bases for 16 common remedial action technologies are provided in supplemental materials appended to this manual

Completion of the Problem Statement

The remedy selection process utilizes the DQO process to ensure that only necessary and sufficient data are obtained. *Necessary* data include any information, the nature/value of which would change the selection of a remedy to an alternative. Data are *sufficient* when the AOC is characterized relative to the fatal flaws and key design parameters of the selected remedy.

When a limited number of likely responses can be identified, the problem statement can be expanded into an "if...then" decision rule. If a single response is not indicated, the "then" portion of the statement can be tiered with an indication of the criteria that would be used to select among the hierarchy of preferred technologies. For example: If lead is found in the top 2 feet of soil in excess of the PRG, 400 mg/kg, across one-quarter acre or more, then a phytoremediation pilot study will be conducted. If the pilot study results indicate the lead PRG can be achieved in less than 3 years, then phytoremediation will be selected as the final remedy. If phytoremediation is not selected, then the soil will be removed and treated for reclamation and/or immobilization of the lead.

Use of the decision rule form for the problem statement furthers its value as a tool for effective communication by clearly identifying the likely responses and the conditions under which each would be selected. Advantages of writing a decision rule statement are that it:

- Provides a clear path forward;
- Reduces potential for unnecessary work; and
- Highlights identity of remaining issues.

To the extent possible, it is good to advise stakeholders of the criteria that will be used to select among alternatives or alert them to a single technology being considered so they can voice concerns early in the process. Ideally, when the final recommendation is made for a remedy, stakeholders will have been prepared and understand how the selection was made.

The third Principle, early identification of likely response actions, applies through all phases of the environmental restoration project. In the pre-decision document phase, it calls for early identification of likely response technologies. In the post-decision document phase it evolves to early identification of the design basis. For stewardship, the third Principle focuses on early identification of long-term

care requirements and the contingencies that should be implemented if performance monitoring suggests objectives are not being met.

Summary

When a problem has been substantiated, the primary purpose of remaining investigatory activities shifts to selection and design of an appropriate response. Hence, there is much to be gained by narrowing the field of probable responses early in the program and using the identity of reasonable alternatives to focus data collection activities. Many times, the field of candidate technologies can be narrowed early enough in the project to accommodate integration of data collection activities needed to substantiate a problem with those used to support selection of the preferred remedy. To the extent that there is a strong likelihood a problem does exist and there are economies with combining the efforts, the early identification of likely responses facilitates streamlining.

EPA guidance on presumptive remedies and prior experience from similar sites are good sources of information from which to select a hierarchy of preferred technologies. Design bases for selected technologies can then be used to identify key data that are required for selection and design activities. Likely response actions are documented as the "then" portion of a decision rule formulation of the problem statement. Criteria for selection among alternative responses should be articulated early and communicated with stakeholders.